

### 3-Level IGBT Module

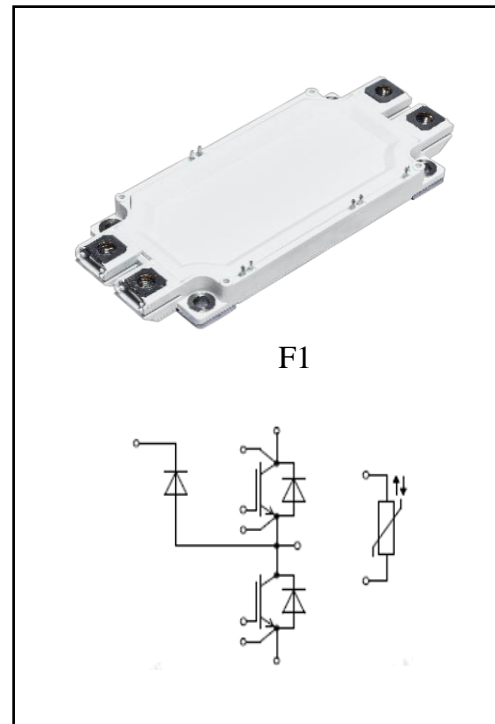
$V_{CES} = 1200V$ ,  $I_{C\ nom} = 450A$  /  $I_{CRM} = 900A$

#### Electrical characteristics :

- 1200V Trench /Field Stop process
- Low switching losses
- $V_{cesat}$  has a positive temperature coefficient

#### Applications:

- 3-Level-Applications
- Energy storage inverter
- Annual Performance Factor
- UPS Systems



### IGBT, Inverter

#### Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Collector-Emitter voltage	$T_{vj} = 25^{\circ}C$	$V_{CES}$	1200	V
Continuous DC collector current	$T_C = 100^{\circ}C$ , $T_{vj\ max} = 175^{\circ}C$	$I_{C\ nom}$	450	A
Repetitive peak collector current	$t_p = 1\ ms$	$I_{CRM}$	900	A
Total power dissipation	$T_C = 25^{\circ}C$ , $T_{vj\ max} = 175^{\circ}C$	$P_{tot}$	1250	W
Gate emitter voltage	$t_p \leq 0.5\ \mu s$ , $D < 0.001$	$V_{GE}$	$\pm 20$ 30	V

**Characteristic Values**

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Collector-Emitter saturation voltage	$V_{GE}=15V, I_C=450A$	$T_{vj}=25^{\circ}C$		1.61	2.1	V
	$V_{GE}=15V, I_C=450A$	$T_{vj}=125^{\circ}C$		1.89		
	$V_{GE}=15V, I_C=450A$	$T_{vj}=150^{\circ}C$		1.96		
Gate-Emitter threshold voltage	$I_C=17mA, V_{GE}=V_{CE}$	$T_{vj}=25^{\circ}C$	$V_{GEth}$	5.3	5.8	6.5
Gate charge	$V_{GE}=-15V...+15V$		$Q_G$		3.12	$\mu C$
Internal gate resistor	$T_{vj}=25^{\circ}C$		$R_{Gint}$		1.9	$\Omega$
Input capacitance	$f=100kHz, V_{CE}=25V,$ $V_{GE}=0V$	$T_{vj}=25^{\circ}C$	$C_{ies}$		34.9	nF
Reverse transfer capacitance			$C_{res}$		1.4	
Collector-emitter cut-off current	$V_{CE}=1200V, V_{GE}=0V$	$T_{vj}=25^{\circ}C$	$I_{CES}$			2
Gate-emitter leakage current	$V_{CE}=0V, V_{GE}=20V$	$T_{vj}=25^{\circ}C$	$I_{GES}$			200
Turn-on delay time	$I_C=450A, V_{CE}=600V$ $V_{GE}=\pm 15V, R_G=2.0\Omega$ (inductive load)	$T_{vj}=25^{\circ}C$	$t_{don}$		168	
		$T_{vj}=125^{\circ}C$			221	
		$T_{vj}=150^{\circ}C$			253	
Rise time	$I_C=450A, V_{CE}=600V$ $V_{GE}=\pm 15V, R_G=2.0\Omega$ (inductive load)	$T_{vj}=25^{\circ}C$	$t_r$		92	
		$T_{vj}=125^{\circ}C$			100	
		$T_{vj}=150^{\circ}C$			101	
Turn-off delay time	$I_C=450A, V_{CE}=600V$ $V_{GE}=\pm 15V, R_G=2.0\Omega$ (inductive load)	$T_{vj}=25^{\circ}C$	$t_{doff}$		427	ns
		$T_{vj}=125^{\circ}C$			485	
		$T_{vj}=150^{\circ}C$			501	
Fall time	$I_C=450A, V_{CE}=600V$ $V_{GE}=\pm 15V, R_G=2.0\Omega$ (inductive load)	$T_{vj}=25^{\circ}C$	$t_f$		86	
		$T_{vj}=125^{\circ}C$			155	
		$T_{vj}=150^{\circ}C$			176	
Turn-on energy loss per pulse	$I_C=450A, V_{CE}=600V,$ $V_{GE}=\pm 15V, R_G=2.0\Omega,$ $di/dt=3500A/\mu s(T_{vj}=150^{\circ}C)$ (inductive load)	$T_{vj}=25^{\circ}C$	$E_{on}$		23.08	mJ
		$T_{vj}=125^{\circ}C$			31.44	
		$T_{vj}=150^{\circ}C$			35.19	
Turn-off energy loss per pulse	$I_C=450A, V_{CE}=600V,$ $V_{GE}=\pm 15V, R_G=2.0\Omega,$ $du/dt=4100V/\mu s(T_{vj}=150^{\circ}C)$ (inductive load)	$T_{vj}=25^{\circ}C$	$E_{off}$		35.59	mJ
		$T_{vj}=125^{\circ}C$			44.33	
		$T_{vj}=150^{\circ}C$			47.24	
SC data	$V_{GE}\leq 15V, V_{cc}=800V$ $V_{CEmax}=V_{CES}-L_{sCE}\cdot di/dt$	$t_p\leq 10\mu s, T_{vj}=150^{\circ}C$	$I_{sc}$		1700	A
Thermal resistance, junction to case	per IGBT		$R_{thJC}$			0.12
Temperature under switching conditions			$T_{vj op}$	-40		150

## Diode, Inverter&3-Level

### Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	$T_{vj}=25^{\circ}\text{C}$	$V_{RRM}$	1200	V
Continuous DC forward current		$I_F$	450	A
Repetitive peak forward current	$t_p=1\text{ms}$	$I_{FRM}$	900	A
I2t-value	$V_R=0\text{V}, t_p=10\text{ms}, T_{vj}=125^{\circ}\text{C}$	I2t	34000	$\text{A}^2\text{s}$

### Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Forward voltage	$I_F=450\text{A}, V_{GE}=0\text{V}$ $T_{vj}=25^{\circ}\text{C}$ $I_F=450\text{A}, V_{GE}=0\text{V}$ $T_{vj}=125^{\circ}\text{C}$ $I_F=450\text{A}, V_{GE}=0\text{V}$ $T_{vj}=150^{\circ}\text{C}$	$V_F$		2.35 2.55 2.45	3.0	V
Peak reverse recovery current	$I_F=450\text{A}, V_R=600\text{V},$ $T_{vj}=25^{\circ}\text{C}$ $V_{GE}=-15\text{V}, R_G=2.0\Omega,$ $T_{vj}=125^{\circ}\text{C}$ $-diF/dt=3500\text{A/us}(T_{vj}=150^{\circ}\text{C})$ $T_{vj}=150^{\circ}\text{C}$	$I_{RM}$		211 297 316		A
Recovered charge	$I_F=450\text{A}, V_R=600\text{V},$ $T_{vj}=25^{\circ}\text{C}$ $V_{GE}=-15\text{V}, R_G=2.0\Omega,$ $T_{vj}=125^{\circ}\text{C}$ $-diF/dt=3500\text{A/us}(T_{vj}=150^{\circ}\text{C})$ $T_{vj}=150^{\circ}\text{C}$	$Q_F$		18.14 42.54 51.06		$\mu\text{C}$
Reverse recovered energy	$I_F=450\text{A}, V_R=600\text{V},$ $T_{vj}=25^{\circ}\text{C}$ $V_{GE}=-15\text{V}, R_G=2.0\Omega,$ $T_{vj}=125^{\circ}\text{C}$ $-diF/dt=3500\text{A/us}(T_{vj}=150^{\circ}\text{C})$ $T_{vj}=150^{\circ}\text{C}$	$E_{rec}$		7.20 18.22 22.08		mJ
Thermal resistance, junction to case	per diode	$R_{thJC}$			0.20	K/W
Temperature under switching conditions		$T_{vj\text{ op}}$	-40		150	$^{\circ}\text{C}$

## NTC-Thermistor

### Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Rated resistances	$T_c=25^{\circ}\text{C}, \pm 5\%$	$R_{25}$		5.0		$\text{K}\Omega$
B-value	$\pm 2\%$	$B_{25/50}$		3375		K

**Module**

Parameter	Conditions	Symbol	Value			Unit
Isolation test voltage	RMS, f=50Hz, t=1min	V <sub>ISOL</sub>	2500			V
Internal isolation			Al <sub>2</sub> O <sub>3</sub>			
Storage temperature		T <sub>stg</sub>	-40		125	°C
Mounting torque for modul mounting		M	3.0		6.0	Nm
Terminal connection torque		M	3.0		6.0	Nm
Weight		W		340		g

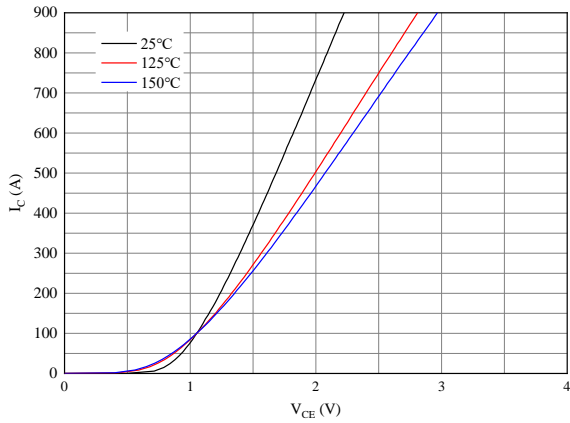


Fig 1. Typical output characteristics ( $V_{GE}=15V$ )

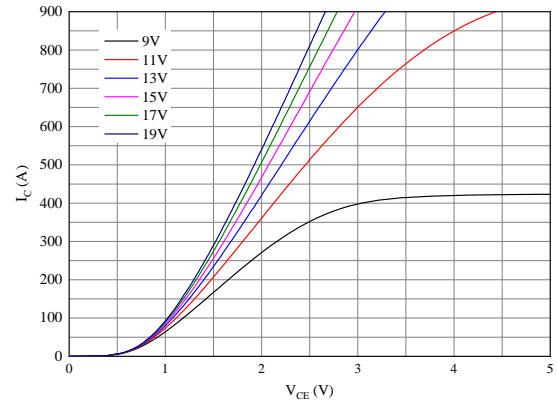


Fig 2. Typical output characteristics ( $T_{vj}=150^{\circ}C$ )

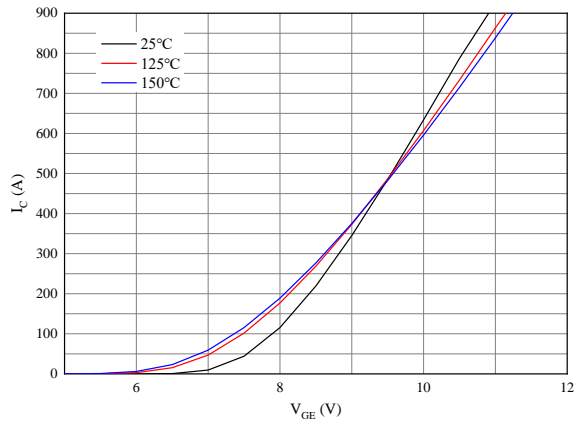


Fig 3. Typical transfer characteristic ( $V_{CE}=20V$ )

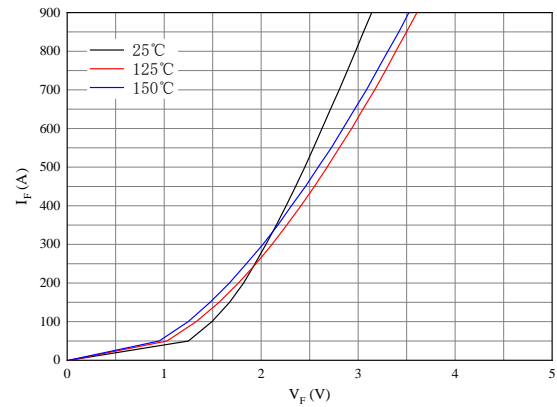


Fig 4. Forward characteristic of Diode

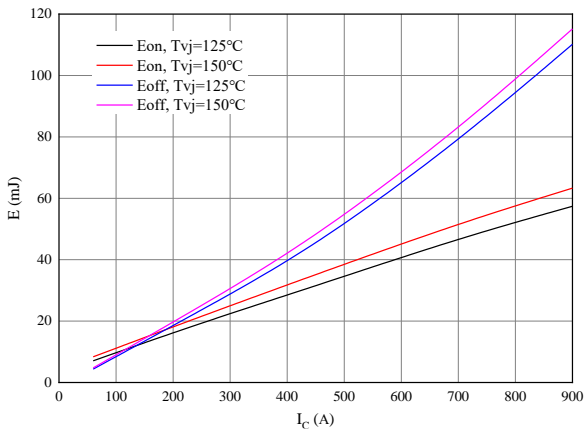


Fig 5. Switching losses of IGBT

$V_{GE}=\pm 15V$ ,  $R_{Gon}=2.0\Omega$ ,  $R_{Goff}=2.0\Omega$ ,  $V_{CE}=600V$

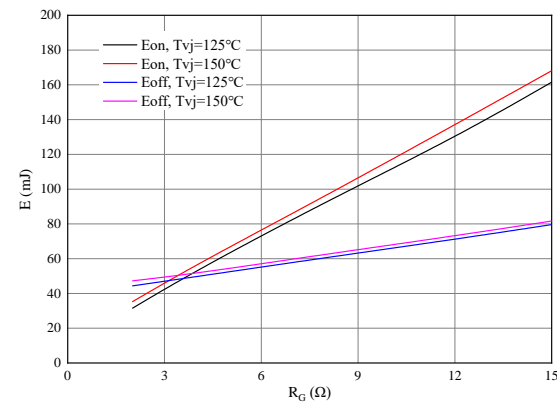
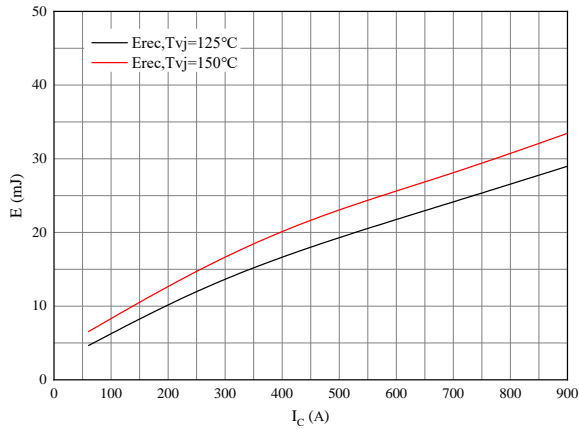
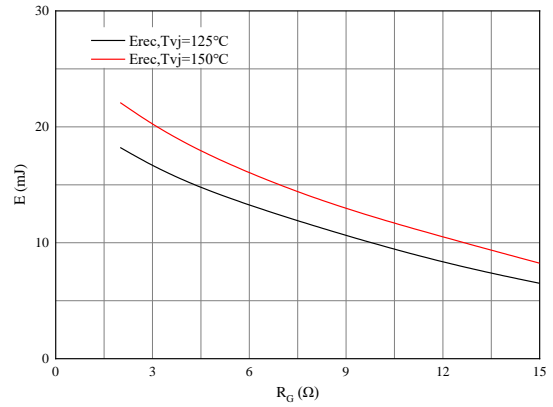


Fig 6. Switching losses of IGBT

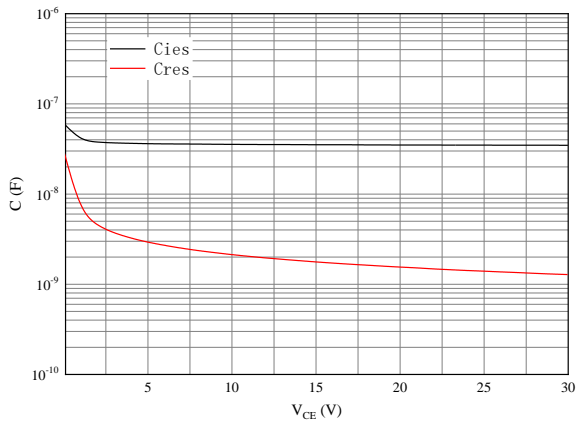
$V_{GE}=\pm 15V$ ,  $I_C=450A$ ,  $V_{CE}=600V$



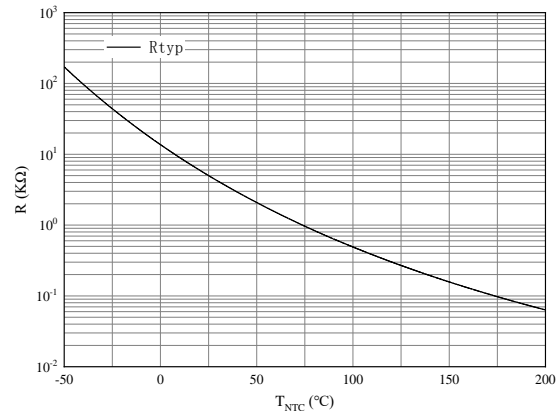
**Fig 7. Switching losses of Diode**  
 $R_{Gon}=2.0\Omega$ ,  $V_{CE}=600V$



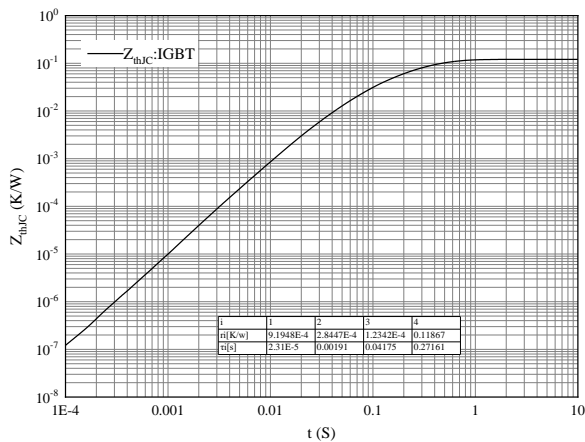
**Fig 8. Switching losses of Diode**  
 $I_c=450A$ ,  $V_{CE}=600V$



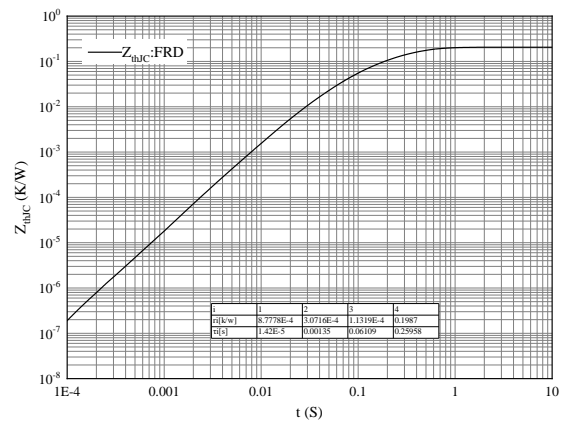
**Fig 9. Capacitance characteristic**



**Fig 10. NTC-Thermistor-temperaturecharacteristic**

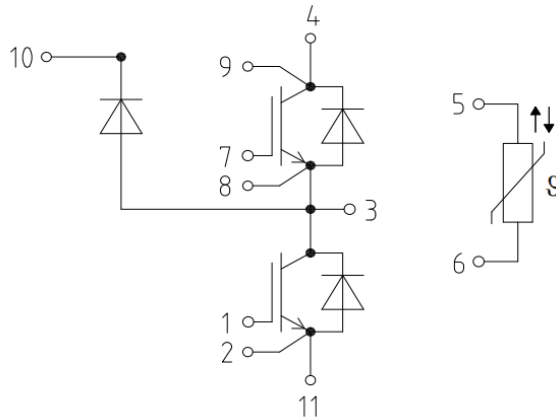


**Fig 11. Transient thermal impedance IGBT, Inverter**  
 $Z_{thJC}=f(t)$



**Fig 12. Transient thermal impedance FRD , Inverter**  
 $Z_{thJC}=f(t)$

**Circuit diagram**



**Package outlines**

